deliver the higher surface and superficial doses than treatment techniques based linear accelerator. It showed adequate dose(over 75% of prescribed dose) at 1mm depth in skin region.

EP-1398

Automated software analysis of multileaf collimator performance in dynamic mode

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Purpose/Objective: The aim of this study was two folds: (i) to implement a software that automatically assess multileaf collimator (MLC) performance in dynamic mode (ii) to analyse MLC performance over a long period of continuous operation.
Materials and Methods: This study was carried out with a Trilogy linac performing Rapidarc® treatments equipped with a Millenium 120 MLC (Varian) . Qualimagiq software solution was used (v5.4.1, Qualiformed, La Roche-Sur-Yon, France). Tests were as follows : (i) four sliding window at gantry 0°, 90°, 270° and 180° (CQ1); (ii) four picket fence at gantry 0°, 90°, 270° and 180° (CQ2) ; (iii) two picket fence with gantry rotation with and without intentional errors (CQ3 and CQ4) ; (iv) dose rate versus gantry speed (CQ5) ; (v) dose rate versus leafs velocities (CQ6). Images were acquired at 6MV with an AS1000 portal imager (EPID) and transferred to the software for data processing and analysis. All these tests were performed once a week for 9 months. Images were corrected from EPID mechanical slack. Acceptable tolerance levels and their uncertainties were taken from publications, manufacturer recommendations, repeatability and short-term reproducibility study.
Results: Weekly images acquisition and associated analysis take about 25 min and 5 min respectively. CQ1, CQ2, CQ4, CQ5 and CQ6 agreed with recommendations. For CQ3, leafs positions were over 0.2mm limit. Further investigations showed that both leaf bank shifted during gantry rotation (0,74mm±0,04mm, clockwise and counter clockwise).
Conclusions: A simple tool to understand and to master for assessing periodically MLC performance in dynamic mode was implemented. Apart from the CQ3 test, they were all within tolerances. Thanks to this tool, we have understood why CQ3 was out of tolerance. A sag in MLC carriage due to the gravity effect happens during gantry rotation. This phenomenon would not have been detected with log files analysis and will be further investigated on other accelerators (2100C/D and True Beam, Varian).

EP-1399

Radiochromic film based dose measurements during radiotherapy 4D CT-simulation

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Purpose/Objective: A 4D CT-simulation is becoming a widely accepted imaging modality for the management of target motion in radiotherapy. As it revolves around slow CT acquisition, it raised questions about the dose patient receives during this procedure. We measured 4D CT dose using radiochromic films on Rando phantom.
Materials and Methods: Pieces of XR-QA2 GafChromicTM film were placed at the surface and between the slabs of the Rando phantom (chest and abdomen region, Fig.1.a). A Pulmonary (retrospective) 4D CT protocol was used on Philips Big Bore CT-simulator to scan both Rando phantom (for dose) and Catphan (for image quality) using 3 different mA settings: 80, 133 (default), and 199. The dynamic Thorax Phantom (CIRS) and the Philips Bellows system were used to trigger the 4D acquisition with a period of 4 seconds. Response of radiochromic film (change in reflectance using red color channel of scanned tiff images on Epson expression 10000 XL document scanner) was calibrated in terms of air kerma in air by irradiating film pieces in the air. Dose to water at the surface of Rando phantom was obtained by multiplying air kerma in air values (derived from measured response of film pieces and strips) by the ratio of mass energy-absorption coefficients water-to-air at a given beam quality following TG-61 protocol.
Results: Fig.1.b shows the basic image quality parameters: image noise and low contrast detectability (LCD), at 0.5% contrast level obtained for 3 tube current settings from uniformity and low contrast sections within Catphan. As expected, with the increased mA setting the image noise decreases while the LCD increases showing the visibility of 15 mm, 6 mm and 5 mm contrast pins at 0.5% contrast level at 80, 133, and 199 mA setting respectively.Fig.1.c represents horizontal (black) and vertical (red) dose profiles through the chest area for default mA setting of 133 mA. Insets indicate the positions of film strips. Fig.1.d shows results of surface dose measurements for three different mA settings at two anatomical levels; chest (solid bars) and abdomen (slashed bars). Doses to ANT-POST aspects are slightly larger than to lateral aspects due to the smaller separation. Also, doses to pelvis region appear to be slightly higher than in the chest region (particularly in ANT-POST direction) due to smaller separation. The highest measurement uncertainty was estimated to be 6%.
Conclusions: For a default 4D CT-simulation mA setting of 133 mA, surface dose ranges from 11 cGy (lateral aspect) to 13 cGy for AP/PA aspect. The highest dose observed was 17 cGy at the anterior aspect of the abdomen region for the 199 mA setting. Doses during the 4D CT-simulation appear elevated, particularly in comparison to diagnostic CT image protocols within the same anatomic regions (2 - 6 cGy). Such dose increase has to be weighted against the benefit of reduced target margins and more accurate dose delivery in the course of radiotherapy of moving targets.